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GL-17: EXTERNAL WALLS AND CLADDING

1. Purpose:

This guideline (GL) relates to the External Walls (including façade cladding) of construction type A or B buildings which cannot be demonstrated as non-combustible. I.e. those not complying with National Construction Code (NCC) Building Code of Australia (BCA) [1] Clause C1.9 or Verification Method CV3.

This GL outlines the key considerations the Department of Fire and Emergency Services (DFES) expects to be included within the submitted Fire Engineering Brief (FEB) and Fire Engineering Report (FER) when addressing the Performance Requirements of the NCC and the Operational Requirements of DFES. It should be read in conjunction with DFES GL – 15 [2], Fire Safety Engineered Performance Solutions, and NCC 2016.

2. Scope:

This guideline relates to the fire engineering assessment of an external wall system (including façade cladding) that does not comply with the BCA Deemed-to-Satisfy (DtS) provisions for non-combustibility. I.e. not complying with AS1530.1 [3]. The GL also provides details of how DFES will consider the applicability of any full scale test results used as evidence to support the proposed external wall system (including façade cladding). This includes those tests detailed in AS5113.

When assessing against the appropriate NCC Performance Requirements, DFES considers that a proposed design must demonstrate that the use of external façade cladding will not:

(a) Result in undue risk of fire spread.

(b) Impact occupant evacuation.

(c) Impact fire brigade intervention.

A number of references have been included in this report that may assist fire engineers and building surveyors in design assessments (refer page 10).

3. NCC Compliance:

3.1 Performance Requirements

The Performance Requirement to be addressed under the NCC for external walls (including cladding products) is CP2 (spread of fire). The intent of CP2 is that external walls do not contribute to the spread of fire in a building or between buildings.

Additional Performance Requirements of the NCC that may need to be appropriately considered include CP4 (tenable conditions for evacuation), CP3 (spread of fire and smoke), DP4 (exits) or EP2.2 (tenable evacuation routes).

3.2 Relevant Deemed-to-Satisfy Provisions

Type A and Type B construction require external walls to be non-combustible (Clause C1.9 / Spec. C1.1 Clause 3.1 and 4.1). A combustible core does not meet the DtS Provisions for these types of buildings.

BCA Clause A0.5 (a) / A2.2 suggests compliance with the NCC may also be achieved via the CodeMark Australia Scheme or the previous CodeMark certification scheme via a 'Certificate of Conformity'. If this route is taken, the fire engineer must demonstrate its applicability (i.e. given any assumptions/limitations) to the subject building's design. This has been acknowledged by CertMark International Advice Note 06/2017 [8].

To provide for a more quantifiable performance assessment, NCC 2016 includes the verification method (CV3). This verification method specifies the required measures needed to avoid fire spread via an external wall under CP2 and also references the AS5113 [4] test. The AS5113 has been based on the international BS8414 [5, 6] and ISO13785 Part 2 [7] tests. Importantly, AS5113 contains additional/modified acceptance criteria (e.g. debris fail parameters).

It should also be noted that although an external wall assembly may comply to AS5113, in most cases additional measures are required to satisfy CV3 (i.e. sprinklers or cavity barriers (CV3(b) – prevention of fire spread between floors via concealed spaces)). CV3 also requires compliance with CV1 and CV2 to be demonstrated.

4. Background:

In 1988, BR 135 [9] was first published as it was recognised the potential range of materials and design solutions for façade systems containing combustible content were increasing. BR 135 recommended a full scale test was required. Subsequent to fire incidents (Knowsley Heights (1991) and Garnock Court (1999), the BS 8414 large-scale tests were developed (including a wing wall to ensure a representative scenario of typical buildings).

Since this period there have been a number of significant external façade fires around the world in multi-storey buildings, including the Lacrosse Building, Melbourne 2014 and in 2017, the Grenfell Tower Apartments in London. The Grenfell fire resulted in over 70 deaths, and physical displacement of the hundreds of remaining residents.

In response to these large-scale fires there have been several post incident reviews initiated by various Governments. For example, following the Grenfell Tower fire, the (DCLG) [10] Building Safety Programme has been investigating and reporting on the safety of cladding systems.

It should be noted that a large-scale external wall (including façade) fire has the potential to create a number of issues for firefighters. Therefore, DFES has reviewed its Operational Requirements, existing procedures, appliance mobilisation and the adequacy of current equipment and service capabilities.

5. Issues:

External walls (including façade cladding) which are considered combustible, may result in:

(a) An increased risk / hazard for fire spread.

(b) Impeded evacuation.

(c) Impeded fire brigade intervention.

6. Considerations:

When considering the use of a potentially combustible external wall system (including façade cladding) the determination of the materials appropriateness should be supported by large-scale façade test data. The assessment submitted to DFES should address the following aspects:

6.1 Fire Brigade Intervention

(a) Site and building access. (e.g. is there aerial appliance access?)

(b) Location and number of nearby fire station/(s).

(c) The extent of onsite fire-fighting facilities, equipment and hard stand areas.

6.2 Design

(a) Testing (i.e. the available test results, their assumptions and limitations including those inherent with Certificates of Conformity).

(b) Building design (i.e. specific building and occupant characteristics).

(c) Material properties and existing data.

Section 7 below provides expanded guidance on design considerations which may impact fire brigade intervention.

7. Design and Fire Brigade Intervention:

7.1 Fire Brigade Intervention

On arrival at a significant external façade fire, timely and accurate information on the current progress of occupant evacuation is crucial. And whilst the first arriving officer/(s) will be concerned with confirming the need for occupant rescue and/or evacuation and the potential for the incident to escalate, the safety of their own crew will be the number one priority. Appliance access and the size of the available hardstand areas, hydrant and sprinkler design capability and the availability/access to any required booster assemblies and additional water supply will be significant influences on the efficiency of the required operational response.

DFES will, however, be relying heavily on the building's preventative fire safety design and construction characteristics to limit the potential of the hazard. In addressing the considerations detailed below, the fire engineering assessment will assist in meeting the needs of DFES Operational Requirements.

7.2 Testing

In demonstrating that the appropriate NCC Performance Requirement/(s) have been met it is critical that the fire engineer considers the assumptions and limitations of the particular full-scale façade test being used as support. DFES considers that the additional assessment criteria (to BS8414 and ISO13785) provided by AS5113 for 'Debris' and 'Flaming' are crucial. These criteria must be specifically addressed in any fire engineering assessment submitted to DFES.

It should also be noted that AS5113 states that … "*the results of fire tests may be used to directly assess fire hazard, but it should be recognised that a single fire test method will not provide a full assessment of fire hazard under all fire conditions*"…

Therefore, analysis of the external wall (including façade cladding) should be consistent with the principles of the IFEG [11]. The assessment provided to DFES must as a minimum consider:

(a) Separation:

   i. Vertical separation (Clause C2.6).

   ii. Cavity barriers / continuous cladding (i.e. prevention of fire spread beyond storey of fire origin).

(b) Layout and orientation of external façade cladding.

(c) Fixing/Installation method of the external façade cladding

(d) Fire size (i.e. test size versus design fire expected).

(e) Relevant openings (i.e. size and proximity to potential fire source).

(f) Core material.

(g) Insulation / substrate materials, and

(h) Whether the external wall (including façade cladding) is load bearing or non-

loadbearing. (i.e. the tests detailed in AS5113 are non-loadbearing).

The following are examples of what might need to be addressed in the assessment:

(a) The subject building's external walls (including façade cladding) is not installed in accordance with the requirements of the relevant test.

(b) The expected design fire may be of an increased fire size (greater than the large-scale test fire (i.e. test is approximately 3MW).

(c) The subject building has decreased fire separation.

(d) The proposed sprinkler protection in the subject building will be limited to some degree. (i.e. AS5113 requires all greater than 25m Type A buildings to have additional sprinkler requirements).

Table 1 below summarises the permitted tests (and also NFPA285) referenced in AS5113 and its consolidated assessment criteria. Consideration should also be given to the additional test set-up requirements. For example, test panels are to be fixed as per the proposed design.

TEST	Fire stopping or separation	Fire Size/type	Key Assessment Criteria			AS5113 Additional Assessment Criteria	Limitations of test
			Temperature	Debris	Flaming		
BS8414-1 (AS5113 Figures 4 and 5 or 4 and 6)	Yes, in accordance with manufacturers specification.	Timber crib (pinus silvestris or pinus radiata) HRR (4500MJ with peak HRRR 3MW)	<600°C at 5 m above opening. Mid depth of layer or cavity <250°C at 5 m above opening for periods not exceed 30s	<2kg after test	Flames or openings to exposed face not to occur. Flame spread beyond specimen not permitted. Continuous flaming on ground of 20 s or more not permitted.	Temperature data. Visual observations of flaming, openings, and debris	- Openings on storey above not considered. - Aluminium or metals with a low melting temperature may not pass the test for debris criteria, although non-combustible. .
BS8414-2 (AS5113 Figures 4 and 5 or 4 and 6)							
ISO 13785-2 (AS5113 Figures 1 and 2 or 2 and 3)		Timber crib or other to same HRR (4500MJ with peak HRRR 3MW)	<600°C at 4 m above opening. Mid depth of layer or cavity <250°C at 5 m above opening				
NFPA285	Not specific however to be installed to manufacturers specifications, and included in test report. Spandrel beam optional.	2 x fires[3]: Calibrated Gas flow rate up to 904kW for room burner (ignited at t=0 mins) Calibrated Gas flow rate up to 398kW for window burner (ignited at t=5 mins)	<538°C at 3.05 m above opening. Combustible component / cavity cannot exceed 417°C temperature increase immediately after test starts.[2] Temperature in room above not to exceed 278°C above ambient.	No criteria.	Flames above the window opening <3.05 m Horizontal spread <1.52m from the opening centreline. Flaming not permitted in room above.	Temperature data. Residual burning monitored for 10 mins after test. Visual observations including smoke in room above, and photos / sketches of damage.	No wing wall included. Perimeter of opening is non-combustible gypsum board (16mm). Spandrel optional.

Notes:
1. *AS5113 includes additional criteria, e.g. .fixed as per the design, sprinkler protection or horizontal projections / spandrels.*
2. *Summarised for brevity, temperature criteria is dependent on a range of thermocouples, and component configuration.*
3. *Fire is representative of a wood crib.*

Table 1 - AS 5113 - Large-scale test parameters

Table 1 also outlines the parameters of the large-scale NFPA285 [12] test, including limitations. However, NFPA285 is not referenced in AS5113.1 and therefore cannot satisfy CV3. It is provided for comparison purposes.

Further, DFES consider the external walls (including façade cladding) proposed in the FEB should not be substituted at construction stage unless the substitute is subject to a full reassessment by an appropriately experienced / qualified fire engineer (or replaced by a non-combustible product or system).

7.3 Building Design

DFES considers that the following characteristics of the building design should be assessed in conjunction with the characteristics of the particular full-scale test being used as support:

(a) Location of external façade cladding including:

i. Quantity and its Orientation (i.e. vertical or horizontal).

ii. Openings (i.e. the size/number and their proximity to a potential fire/ignition source).

iii. Proximity to exits or the designated building entry point.

iv. Fire brigade external fire fighting capability. (e.g. access for aerial appliance)

(b) Core material and insulation / substrate materials:

i. Materials test results. (e.g. polyurethane and polyisocyanurate foams will, when ignited, produce irritating smoke and gases which are highly toxic).

(c) Provision or omission of fire protection systems. (i.e. sprinklers to balconies and/or cavity barriers).

(d) Prevention measures proposed for fire spread, within and, to and from the building.

(e) Control measures in place, including:

i. Limitations of fuel load.

ii. Limitations of ignition sources. (i.e. Non-combustible cladding to lower levels).

(f) Building specifics:

i. Number of storeys.

ii. Floor plan, including location and number of exits.

iii. Mixed-Classification.

(g) Occupant characteristics related directly to evacuation:

i. Alertness.

ii. Physical and/or mental impairments.

iii. Familiarity with building and/or its operations.

(h) Additional Performance Solutions being proposed. For example:

i. Non-compliant fire appliance perimeter access.

ii. Reduced FRL's and/or enlarged fire/smoke compartments.

iii. Omission of fire hydrant pumps and tanks.

iv. Exposure to hydrants / hydrant booster cabinet.

v. Extended travel distances.

vi. Non – DtS discharge of fire isolated stairways and exits.

7.4 Material Properties and existing data

As part of any submitted performance based assessment, DFES will consider the increasingly available information related to external façade cladding. For example, Table 2 below summarises the DCLG BRE Group BS8414 screening tests for polyethylene (PE) core Aluminium Composite Panels (ACPs) and wall insulation. The scenarios were based on typical industry examples, and confirm materials which are likely to and unlikely to pass a full scale façade test to AS5113.

BRE Test Number	Cladding Type	PE content	BRE Category	Insulation Type (PIR / Stone wool)	Resistance to spread of fire	Risk Rating
1	Unmodified polyethylene filler	50-100	3	PIR foam	Fail	High / Significant
2				Stone wool		
3	Fire retardant polyethylene filler	30 (70% inert materials)	2	PIR foam	Fail	High (Lower if used with non-combustible insulation)
7				Phenolic foam		
4	Fire retardant polyethylene filler	30 (70% inert materials)	2	Stone wool	Pass (13.6 Mj/Kg average calorific value)	High (Lower if used with non-combustible insulation)
5	A2 filler	7 (93% inert materials)	1	PIR foam	Pass	Low risk when used in conjunction with non-combustible insulation and cavity barriers / fire breaks
6				Stone wool		

Note(s):

1. *Cavity barriers were provided for all tests.*
2. *Different products from different manufacturers may behave differently in fire, the composition of polyethylene filler and fire retardant need to be verified for each scenario.*
3. *Fixing methodology, provision of cavity barriers and maintenance can affect a system.*
4. *It should also be noted that the Insurance Council of Australia has provided its own guidance note that makes use of the BRE testing. This note is available on their web page at www.insurancecouncil.com.au [14].*

Table 2- Category of ACP (Reproduced from BRE / DCLG [10])

It should also be noted that the Association of British Insurers (ABI) [13] commissioned the Fire Protection Association to investigate the robustness of the BS 8414 testing method. The objective being to investigate potential overall safety improvements and to provide better data to support future material selections and designs. Amongst its findings were:

i. Current testing to BS 8414 represents an idealised (more robust) fitting and is not representative of real world application.

ii. If an equivalent fuel load comprising 20% polypropylene and 80% timber, was compared to the prescribed 100% timber crib test, the peak temperature is 100°C higher , the fire growth quicker and the flame length longer – this having implications for aluminium which has little to no strength at 500°C.

Similarly, in February 2018, the NFPA [13] released a fire risk assessment tool called EFFECTTM. This tool is intended to be used by an AHJ when conducting an initial review of external walls in existing Class 2, 3 and 5 buildings. Therefore, whilst it may provide assessment criteria to be considered in assessing external façade cladding, it is not appropriate for all building classifications or intended to replace the necessary input required of a qualified / experienced fire engineer (including other stakeholders where relevant) when assessing a building design against the relevant Performance Requirements of the NCC.

These reports and tools may provide the stakeholders involved in the fire engineering assessment a relevant starting point to commence discussions on the appropriateness of the external wall system (including façade cladding).

8. Conclusion:

As outlined in Clause 0.3.3 of the IFEG "Many Buildings appear to have similar or identical design features. However, detailed examination generally reveals variations, some of which can have a major influence on the fire safety of the building. Thus using one building or features of that building as a precedent for approval for another is not appropriate except in exceptional circumstances".

DFES will review all submissions on their merit, however the above points are provided as an indication of the approach that DFES considers appropriate when building designers, including fire engineers and building surveyors, assess the suitability of external facade cladding against the Performance Requirements of the NCC.

9. Definitions:

The following definitions apply for the purpose of this guideline:

ACP: aluminium composite panel.

AHJ: Authorities Having Jurisdiction.

Certificate of conformity: a certificate issued by the ABCB scheme for building products and systems (i.e. codemark certificate satisfying A2.2).

Combustible: means not having a test in accordance with AS1530.1 as defined in the NCC to determine combustibility or be permitted under NCC concessions (C1.12 (C1.9 Amend. 1).

Core material: the material sandwiched between the outer (aluminium or steel) layers of the external façade cladding (and not the adhesive layer).

External Façade Cladding: means the external visible face of a building comprising façade, outer skin, cavities and attachments (as defined in AS5113), cladding is considered integral (and not ancillary) to the construction of the wall.

External wall: an outer wall of a building which is not a common wall.

Fire-rated: means fire-resistant, fire-retardant or having limited combustibility (but does not infer non-combustible).

Heat Release Rate: is the rate at which fire releases energy and is measured in units of Watts (W), usually denoted in Kilowatt (kW).

Loadbearing: means intended to resist vertical forces additional to those due to its own weight.

Non-combustible: a material – not deemed combustible as determined by AS1530.1 – combustibility tests for materials [3]; and applied to construction or part of a building – constructed wholly of materials that are not deemed combustible.

Substrate: means inner layer (i.e. insulation behind the outer façade).

For further clarification on the above definitions refer to the documents referenced in this guideline, including NCC Section A1.1.

10. References:

1. National Construction Code (2016), Volume 1 (incorporating Amendment 1, when adopted 12 March 2018), Australian Building Codes Board, ACT, Australia.
2. GL-15 (2012) Department of fire and emergency services, Built environment branch, Guideline 15, Fire engineered performance solutions. [ONLINE] Available at: https://www.dfes.wa.gov.au/regulationandcompliance/buildingplanassessment/pages/publications.aspx [Accessed 9 March 2018].
3. AS1530.1 (1994) Methods for fire tests on building materials, components and structures, Part 1, combustibility test for materials, Strathfield, NSW, Australia.
4. AS5113 (2016) Fire propagation testing and classification of external walls of buildings, Strathfield, NSW, Australia.
5. BS-8414 (2015) Fire performance of external cladding systems, Part 1, Test method for non-loadbearing external cladding systems applied to the masonry face of a building.
6. BS-8414 (2015) Fire performance of external cladding systems, Part 2, Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame.
7. ISO 13785-2 (2002) Reaction to fire tests for facades, Part 2, Large-scale test.
8. CertMark International (2017), Advisory Note 06/2017, Aluminium Composite Panels (ACP), Fire Risk, Australia and New Zealand. [ONLINE] Available at: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Economics/Non-conforming45th/Additional_Documents [Accessed 19 February 2018].
9. BR 135, Fire Performance of External Thermal Insulation for Walls of Multi Storey Buildings, BRE Trust, Garston, Watford, WD25 9XX, UK.
10. Department of Communities and Local Government (2017), BRE Global ACP/Insulation BS8414-1 Fire Tests. [ONLINE] Available at: http://www.insurancecouncil.com.au/assets/aluminium%20protocol/BRE_NOTES_ANEXURE.pdf [Accessed 9 February 2018].
11. International Fire Engineering Guidelines, (2005), Australian Building Codes Board, ACT, Australia.
12. NFPA 285 (2012), Standard fire test method for evaluation of fire propagation characteristics of exterior non-load-bearing wall assemblies containing combustible components, National Fire Protection Association, 1 Batterymarch park, Quincy, MA, USA.
13. ABI (2018), Cladding Approvals: A review and investigation of potential shortcomings of the BS8414 standard for the approval of cladding systems such as those used on tall buildings, Association of British Insurers, 17 Croswell, London, United Kingdom.
14. NFPA (2018), High rise buildings with combustible exterior wall assemblies – Fire Risk Assessment Tool, National Fire Protection Association, 1 Batterymarch park, Quincy, MA, USA. [ONLINE] Available at: https://www.nfpa.org/News-and-Research/Resources/Fire-Protection-Research-Foundation [Accessed 19 February 2018].
15. Insurance Council (2018). Insurance industry aluminium composite panel's residual hazard

identification/reporting control. [ONLINE] Available at: http://www.insurancecouncil.com.au/issues-submissions/issues/insurance-industry-aluminium-composite-panels-residual-hazard-identificationreporting-protocol [Accessed 9 February 2018].

16. ABCB Advisory note 2018-2, Fire Performance of External Walls and Cladding (February 2018), Australian Building Codes Board, ACT, Australia.
17. AS2118.1, (1999 / 2017) Automatic Fire Sprinkler Systems, Part 1: General Requirements, Standards Australia, Strathfield, NSW, Australia
18. Guidance on fire safety Performance Solutions, Building Commission, Department of Mines, Industry Regulation and Safety. [ONLINE] Available at: https://www.commerce.wa.gov.au/sites/default/files/atoms/files/guidance_on_fire_safety_performance_solutions_0.pdf [Accessed 07 March 2018].

12. Legislation:

Building Act 2011

Building Regulations 2012 (as amended)

Fire Brigades Act 1942

Emergency Management Act 2005

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Contact us

Department of Fire and Emergency Services
Built Environment Branch
20 Southport Street West Leederville, WA 6007
PO Box P1174 Perth WA 6844
Email: bebadmin@dfes.wa.gov.au
Web: www.dfes.wa.gov.au